Of the comet discovered by Dr. Tempel at the Observatory of Arcetri, near Florence, on October 2, the following elements by Dr. Schur are also from Prof. Winnecke :—

Perihelion passage June 27·970 M.T. at Berlin.

Longitude of perihelion	83° 30′·0
,, ,, ascending node	184 17·8
Inclination	64 54·2
Log. perihelion distance	0·00994

Motion—retrograde.

On June 28 the comet was in R.A. 5h. 51m., N.P.D. 34°·4, distant from the earth 1·71; on August 1 in R.A. 4h. 47m., N.P.D. 38°·8, distance 1·35 ; and on September 3 in R.A. 2h. 36m., N.P.D. 55°·4, distance 0·79, so that an earlier discovery might have been expected.

The places subjoined are from these elements for 12h. G.M.T. :—

		R.A. h.	m.	N.P.D. °	′	Distance from the Earth.	Distance from the Sun.
Oct.	18	23	5·5	112	54	1·241	2·036
,,	20	23	2·0	113	48		
,,	22	22	58·9	114	37	1·350	2·084
,,	24	22	56·0	115	20		
,,	26	22	53·5	115	58	1·462	2·132
,,	28	22	51·3	116	31		
,,	30	22	49·4	117	2	1·577	2·180
Nov.	1	22	47·7	117	29		
,,	3	22	46·3	117	54	1·695	2·227

BIOLOGICAL NOTES

BORING POWER OF MAGILUS.—We have received from Mr. Charlesworth a preliminary note giving briefly a result of his study of the genus Magilus, the remarkable testaceous gasteropod that is found immersed in the large hemispherical corals of the genus Meandrina. The current belief, as set forth by Sowerby, Owen, Woodward, and other authorities in molluscan biology who have treated of this coral-inhabiting mollusc, is that Magilus in its young state effects a lodgment in a crevice of a Meandrina, and that as the coral enlarges, the Magilus extends the margins of the mouth of its shell in the form of a cylindrical corrugated tube, the growth of this tube and of the coral proceeding together *pari passu*, and consequently that there is no penetration of the coral by the Magilus at all. Mr. Charlesworth, however, finds that Magilus not only drives through solid masses of coral in any direction with apparently the same facility that the bivalve Teredo tunnels masses of wood, but he finds that it even surpasses Teredo in its power of suddenly reflecting its shell and returning to the point from which it commenced its advance ; and this bending back of the shell upon itself is not accomplished in such natural cavities as frequently prevail in large corals of the Meandrina genus, but in the solid mass of the coral.

GREAT VITALITY OF ANTS.—Several interesting observations have been made by the Rev. H. C. McCook on the endurance of extremes of heat and cold by ants. This year a formicary of *F. pennsylvanica* was cut from an oak bough and exposed out of doors to the rigour of a mountain winter, and survived. A number were dropped separately upon ice, and were found alive after forty-eight hours, each in a little depression. *F. rufa* was found active in its formicary at 34° F., sluggish at 30°. The extreme of heat seemed also to be endured by *F. pennsylvanica;* they did not suffer at all from the heat of stones walling in a camp fire, having been driven into this position out of a burning stump. A community of agricultural ants (*M. molefaciens*) lived in a mound upon which some smiths in Texas made their fires for heating waggon tires. Numbers of ants were seen at work by Dr. Lincecum, cleaning out the entrance to their city, before the entire extinction of the fire just used for heating tires. They had learnt all about the fire, and knew how to work in and around the dying embers without injury. A quantity of mason ants (variety of *F. rufa*) observed by Mr. McCook were accidentally flooded under five inches of water, and they appeared to be quite dead, and floated about in this condition for many hours. But subsequently most of them recovered full activity. In Texas Mr. Lincecum found that the agricultural ants are seen in great numbers in wells, forming a sort of floating mass as large as an orange, clinging together. In this condition they get drawn up in the bucket, and though they may have been in the water a day or two, they are all found alive. Yet individuals cannot survive under water more than six minutes ; and life in these balls can only be preserved by the mass revolving, either by the continued struggles of the individual insects, or by an instinctive and orderly movement of the outer tier of ants (*Proc* Acad. Nat. Sci. Philadelphia, 1877, p. 134).

THE STRIPED MULLET.—This fish, so abundant off the coast of North Carolina, seems to suffer from several serious drawbacks, which would appear to threaten its extinction. It moves through the water so slowly that a man may easily walk as fast. The young fry suffer from a disease which gradually destroys the sight, and great numbers perish ; they are also much infested with parasitic worms. To counterbalance these destructive agencies, the female has an enormously distended roe.

THE MEDITERRANEAN FLORA.—From personal observations in Italy and Greece, with the aid of literature bearing on the subject, M. Fuchs comes to the conclusion that the so-called Mediterranean flora, so far as represented by evergreen woody plants, and plants of the sage, thyme, lavender, and rosemary order therewith always associated, occurs, at least in France, Italy, Greece, Southern Russia, and Northern Asia Minor, exclusively on calcareous formations, while soils with little or no lime (granite, gneiss, flysch, sandy and muddy alluvia of rivers) in the whole of that region, and south to Sicily and Morea, bear exclusively deciduous foliaceous trees, and in general, a vegetation hardly differing from the ordinary central European flora. We are not, however (M. Fuchs says), to conceive the phenomenon as if the former class of plants required the lime as nutriment; the correct view rather is, that the southern evergreen flora is better able to press northwards on the drier and warmer calcareous formation, than on the damper and colder clayey soil. And he finds support of this view in the fact that, in the Azores, Madeira, and the Canary Islands, with a truly subtropical climate, an evergreen shrub vegetation closely agreeing with the Mediterranean flora flourishes on various soils indifferently, even on basaltic and trachytic rocks. The same appears to be the case in Algiers.

FOX TALBOT

HAD the photographic art never been invented, Mr. W. H. Fox Talbot, whose death we recently recorded, would have a claim to take a good rank as a scientific investigator. In the popular estimation his work in connection with photography is what alone gives him a claim to remembrance ; but we are sure there are many of our readers who must be familiar with writings by him in various departments of science. He was indeed in many respects a wonderful man, and a glance at the Royal Society Catalogue will show that he has left behind him a great amount of varied work. In mathematics, in physics, in chemistry, in astronomy, in botany, in archæology, in literature, Fox Talbot at various periods of his life did substantial work, and in addition filled faithfully and liberally the responsible position of an English country gentleman on his estate of Lacock Abbey, Wiltshire.

Fox Talbot was the eldest son of Mr. William Davenport Talbot, his mother being a daughter of the Earl of Ilchester. He was born in February, 1800, and received his early

education at Harrow. Thence he went to Trinity College, Cambridge, where he gained the Porson Prize in 1820, was Chancellor's Gold Medallist, and graduated in 1821 as Twelfth Wrangler. Just after the passing of the first Reform Bill he sat for two years in Parliament as member for Chippenham, when he retired from public life, and devoted himself almost entirely to work in various departments of science and literature. In the Royal Society's Catalogue alone is a list of about fifty papers by him in various domains of science, and ranging from the year 1822 the year after his graduation, down to 1872. The first paper on the list is a mathematical one contributed to Gergonne's *Ann. Math.* (1822), "On the Properties of a certain Curve drawn from the Equilateral Hyperbola." In 1822-23 he contributed six mathematical papers to the same journal, one of them being "On a Curve the Arcs of which represent Legendre's Elliptic Functions of the first kind." He was the author of at least eight other mathematical papers contributed to the Royal Society, the *Phil. Trans.*, and the *Transactions* of the Royal Society of Edinburgh. Some of these papers are very remarkable, as those on Definite Integrals, and show Fox Talbot to have been a mathematician of no small power.

He seems to have commenced his researches on light at an early period. There is, for example, in the *Edinburgh Journal of Science*, for 1826, a paper describing "Some Experiments on Coloured Flames;" and in the *Quarterly Journal of Science*, for 1827, one "On Monochromatic Light." Other papers in the same direction appear in the *Phil. Mag.*, for 1833, "On a Method of Obtaining Homogeneous Light of Great Intensity," "Experiments on Light," 1834, "On the Nature of Light," 1835 In 1861 he published in the *Chemical News* papers on "Early Researches on the Spectra of Artificial Light from Different Sources," and "Some Experiments on Coloured Flames;" and so late as 1872, we find in the *Proceedings* of the Royal Society of Edinburgh, "Notes on Some Anomalous Spectra," "On the Early History of Spectrum Analysis," and "On a New Mode of Observing Certain Spectra."

In chemistry, as might be expected, his researches were many, being mainly connected, however, with photography. One of his earliest chemical papers will be found in the *Phil. Mag.* ii. 1833: "Remarks on Chemical Changes of Colour." We find other papers contributed mainly to the *Phil. Mag.* on Nitre, Iodide of Silver, Iodide of Mercury, &c.

In January, 1839, Daguerre published his account of his process. On the 31st of the same month Fox Talbot gave an account of his own process to the Royal Society, in a paper entitled "Some Account of the Art of Photogenic Drawing, or the process by which Natural Objects may be made to delineate themselves without the aid of the artist's pencil" (*Roy. Soc. Proc.* 1839; *Phil. Mag.* xiv. 1839); and at the meeting of the British Association that year he read a paper on the subject. From that time onwards he continued to write papers in connection with his invention, though for several years before his death he seems to have lost his interest in the subject, and turned his versatile intellect to other lines of inquiry.

The original photogenic drawing is nothing more nor less than the silver printing process of the present day, which has received little or no modifications since it passed out of his hands, unless it be the application of albumen to the paper and the fixing with sodium hyposulphite. Early in 1840 a new process due to Talbot created a sensation in scientific circles, the results being a marked advance on everything that up to that time had been produced. This was no other than the Calotype or "beaut ful picture" process, a patent for which he took out dated 1841. The main features of this process may be described as the production of a photographic picture on sensitised silver-iodide, held *in situ* in the pores of paper, and its development by means of gallic acid. The credit of the discovery of this method of development has often been ascribed to Fox Talbot; but we believe that to the Rev. B. J. Reade it is really due, but was so modified by Fox Talbot as to render it manageable in the hands of the operator. The next patent that Fox Talbot took out was registered under the title of "Improvements in Calotype," in which, amongst other things, he included fixing the photographic image on the paper by means of sodium hyposulphite, a solvent for the haloid salts of silver which Sir John Herschel had used in February, 1840.

The third patent taken out by Talbot, in conjunction with Malone, was for the use of unglazed porcelain in lieu of glass, on which to support the photographic image, using an albumen process. In this patent also we have a protection granted for an invention which has several times since been rediscovered, viz., the use of a transparent and flexible support in lieu of glass capable of being adapted to a curved surface, by which means a panoramic view might be taken in the camera by the gradual rotation of the lens round its optical centre. This flexible support was paper rendered transparent and non-absorbent of the liquid albumen applied to its surface. The last novelty included consisted of an application of photography to the production of an image on steel plates, doubtless with a view of helping the engraver.

The fourth patent was for a process (described in the *Athenæum*, December 6, 1851) by which instantaneous pictures could be taken, and was so sensitive that an experiment undertaken at the Royal Institution to prove its value is worthy of redescription. Printed matter was fixed on a wheel which was caused to revolve at a rapid rate, and being illuminated by the spark from a battery of Leyden jars, a facsimile of it was produced in the camera, "every letter being perfectly distinct." We doubt if at the present day any greater degree of instantaneity could be secured even by the most rapid collodion processes extant. The success of the process was due to the extreme sensitiveness of silver iodide when prepared by double decomposition of the iron salt, and also to the great facility with which silver nitrate could be reduced by ferrous sulphate. The debt he owed to Dr. Woods, of Parsonstown, and to Robert Hunt, who respectively discovered these facts, Talbot duly acknowledged in his communication to the *Athenæum*.

The last patented invention in photography with which Fox Talbot's name is connected was that of photographic engraving. This process is based on the discovery by Poitivin, of the possibility, by exposure to light, of forming an image in gelatine when impregnated with bichromate of potassium. The steel-plate on which the etching was to be engraved was covered with a dried layer of thin chromated gelatine, and after exposure in the camera the plate was placed in cold water to remove part of the gelatine and as much of the bichromate as possible. It was then covered with the etching fluid which penetrated in a greater or less degree through the gelatine film and the "biting-in" thus effected enabled the plate when inked up and printed in the usual manner to give an impression on paper of the object photographed. This method was most successful in the reproduction of line engravings, and when half tones had to be produced he adopted other artifices to which we need not here refer.

It has been stated that Fox Talbot did not protect his processes, but the above list of patents at once contradicts the assertion. Not only did he—as we think quite justifiably—do so, but he strictly claimed his rights, even going so far as to bring an unsuccessful action for infringement, claiming to include in his Calotype patent—which was essentially a paper process—the collodion process of Le Gray and Archer. Mr. P. Le Neve Foster writes to us that Fox Talbot was so tenacious of his rights that the formation of the Photographic Society was for a time prevented. "I had," Mr. Foster writes, "more

than one conversation with him at that time on the subject, and he only yielded, and in favour of amateurs, after much solicitation on the part of the late Lord Rosse and Sir Charles Eastlake, who thereupon became the first president of the Photographic Society."

The accompanying extract from the correspondence which appeared in the *Times* of August 13, 1852, between the inventor of the Calotype process and the presidents of the Royal Society and Royal Academy, shows the spirit in which the two latter approached the subject of the patent rights, and the generous tone in which the former responded :—

"The art of photography on paper," Lord Rosse and Sir Charles Eastlake write, "of which you are the inventor, has arrived at such a degree of perfection that it must soon become of national importance ; and we are anxious that, as the art itself originated in England, it should also receive its further perfection and development in this country. At present, however, although England continues to take the lead in some branches of the art, yet in others the French are unquestionably making more rapid progress than we are. It is very desirable that we should not be left behind by the nations of the Continent in the improvement and development of a purely British invention ; and, as you are the possessor of a patent right in this invention, which will continue for some years, and which may, perhaps, be renewed, we beg to call your attention to the subject, and to inquire whether it may not be possible for you, by making some alteration in the exercise of your patent rights, to obviate most of the difficulties which now appear to hinder the progress of art in England. Many of the finest applications of the invention will probably require the co-operation of men of science and skilful artists. But it is evident that the more freely they can use the resources of the art, the more probable it is their efforts will be attended with eminent success. As we feel no doubt that some such judicious alteration would give great satisfaction, and be the means of rapidly improving this beautiful art, we beg to make this friendly communication to you in the full confidence that you will receive it in the same spirit—the improvement of art and science being our common object."

This letter is dated "London, July," and Fox Talbot replied as follows, under date "Lacock Abbey, July 30":—

". . . I am as desirous as any one of the lovers of science and art, whose wishes you have kindly undertaken to represent, that our country should continue to take the lead in this newly-discovered branch of the fine arts ; and, after much consideration, I think that the best thing I can do, and the most likely to stimulate to further improvements in photography, will be to invite the emulation and competition of our artists and amateurs by relaxing the patent right which I possess in this invention. I therefore beg to reply to your kind letter by offering the patent (with the exception of a single point hereafter mentioned) as a free present to the public, together with my other patents, for improvements in the same art. . . . The exception to which I refer, and which I am desirous of keeping in the hands of my own licensees, is the application of the invention to photograph taking for sale to the public. This is a branch of the art which must necessarily be in comparatively few hands. . . . . With this exception, then, I present my invention to the country, and trust that it may realise our hopes of its future utility."

In the *Phil. Mag.* iii. 1833 will be found a very curious paper, which might interest Sir Wm. Thomson (who, however, has probably read it), "On the Velocity of Electricity ; a proposed method of ascertaining the greatest depth of the ocean." Crystallography and optics came in for a considerable share of Talbot's attention. In 1836, in the *Comptes Rendus*, we find him describing researches on borax crystals, and besides various papers on the subject mentioned produced in 1836, he gave the Bakerian lecture of that year, the subject being "Facts relating to the Optical Phenomena of Crystals." In 1842 he read a paper at the British Association "On the Improvement of the Telescope," and another in 1847 "On a New Principle of Crystallisation." He describes in the Astronomical Society's *Memoirs* (xxi.) a total eclipse of the sun, July 28, 1851, observed at Marienburg, Prussia, and in the British Association Report for 1871 will be found a paper by him "On a New Method of estimating the Distances of some of the Fixed Stars."

The subject of heat also had its attractions for his many-sided mind, and in 1836 he contributed to the *Phil. Mag.* papers on the Repulsive Power of Heat and on Radiant Heat. Even botany received a share of his attention, for we find in the *Transactions* of the Edinburgh Botanical Society for 1868 a "Note on *Vellozia elegans* from the Cape of Good Hope."

But the half is not told, and it would take up more space than we can spare, even were it quite appropriate in these pages, to refer to his numerous contributions in literature and archæology to the Royal Society of Literature (of which he was vice-president), the Society of Biblical Archæology, and by other methods. Orientalists will call to mind that Talbot was one of the first who, with Sir Henry Rawlinson and Dr. Hincks, deciphered the cuneiform inscriptions brought from Nineveh. He was the author of several books of much interest and learning, and in his "Pencil of Nature," a fine quarto published in 1844, and probably the first work illustrated by photographs, he describes the origin and progress of the conception which culminated in his invention.

THE PHOTOGRAPHIC EXHIBITION

THE Photographic Exhibition which is now open at 5A, Pall Mall East, is well worthy of a visit by all lovers of the art-science, exemplifying as it does the progress that has been made in dry-plate processes. The perfecting of these processes must have a marked effect on the future of photography, as when they are capable of being employed under all circumstances, the heavy paraphernalia attendant on the wet process may be consigned to the lumber-room, and the worker in the field or laboratory need only be dependent on his box of sensitive plates and his camera. We cannot enumerate all the processes, examples of which are exhibited. We may mention, however, that the simple bromide of silver emulsion either held on the plate embedded in collodion or gelatine appears to bear away the palm for excellence, unless it be the process with which Mr. England has produced his splendid collection of Swiss views, in which (though no information is given in the catalogue regarding it), we think we can trace the delicacy due to albumen in the sensitive film, combined probably in some way or another with bromide of silver. Another feature of the exhibition are the enlargements which are shown by various exhibitors, amongst whom we may name, as being specially worthy of mention, the Woodbury Company, the Royal Engineers, and the Autotype Company. The enlargements taken by Mr. E. Viles with the microscope are also worthy of more than a passing remark. They are all beautifully executed, but perhaps the picture of the proboscis of the common blow-fly should be specially singled out, being almost perfectly enlarged to 200 diameters. We believe that a comparatively low-power objective was employed, and that from the small negative obtained by it an enlargement in Monckhoven's solar camera was produced. These pictures are hung too high to be well seen, and Mr. Viles perhaps might be persuaded to show them at some of this season's scientific *soirées*. As regards the application of photography to scientific purposes there are no other examples to be found in the exhibition, a matter which we deeply regret, seeing the